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Microelectrodes have been fabricated as cylinders and as disks or arrays of disks, by employing both conventional and e-beam lithography techniques. Theory has been developed for diffusion to a disk for a variety of electrochemical techniques, especially square wave voltammetry. Cylindrical carbon fiber electrodes have been used as substrates for anodic stripping voltammetry. Small mercury electrodes have been used as tools for investigating anodization reactions in the absence of supporting electrolyte. The properties of low current at high current density and short diffusional relaxation times have been used for applications to corrosion problems.

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ELECTROCHEMISTRY AT VERY SMALL ELECTRODES

This project included two tasks, one of which was devoted to work in molten salts and which was terminated early in the life of the contract. This work is described in publications 1, 2, 6, and 7. The rest of the work deals with electrochemistry at very small electrodes. Publications 3, 4, 10, 13, and 19 deal primarily with the fundamental theoretical groundwork which makes possible quantitative description of the voltammetric response at microelectrodes. Publications 5, 8, 9, 22, and 23 are primarily experimental demonstrations of some of the characteristics and possibilities of electrodes made of various materials and in various shapes. Publications 8 and 9 in particular deal with the only e-beam lithographic arrays which have to our knowledge been made. Publications 11, 14, 15, and 16 deal with applications of microelectrodes in analytical chemistry, whereas 12 and 18 deal with applications to kinetic studies. Publication 17 explores the important area of microelectrode behavior in pure solvents.

Publication 20 demonstrates the utility of microelectrodes in corrosion studies. Publication 21 demonstrates the application of the concepts developed here to the study of superconducting electrode materials.

Under the previous and present contract both the theory and practice of pulse voltammetry at microelectrodes have progressed from difficult and uncertain laboratory art to tools with many possibilities for application in electrochemistry, chemistry, chemical analysis, and material science.

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3. Chronopotentiometry at Very Small Stationary Disk Electrodes, Koichi Aoki, Koji Akimoto, Koichi Tokuda, Hiroaki Matsuda, and Janet Osteryoung, May 1, 1985.

4. Square Wave Voltammetry at Electrodes Having a Small Dimension, John O'Dea, Marek Wojciechowski, Janet Osteryoung, and Koichi Aoki, May 1, 1985.

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6. Impedance Relaxation Spectrum for Small Passivating Chromium Electrodes, Tadeusz Hepel and Janet Osteryoung, September 25, 1986.

7. Electrochemical Characterization of Electrodes with Submicrometer Dimensions, Tadeusz Hepel and Janet Osteryoung, September 25, 1986.

8. Square Wave Voltammetry at Small Disk Electrodes: Theory and Experiment, David P. Whelan, John J. O'Dea, Koichi Aoki, and Janet Osteryoung, September 25, 1986.

9. Mercury-Coated Carbon Fiber Microelectrodes: Preparation and Some Properties,Janusz Golas and Janet Osteryoung, September 25, 1986.

10. Determining Kinetic Parameters from Pulse Voltammetric Data, John O'Dea, Thomas Lane, and Janet Osteryoung, September 25, 1986.

11. Reversible Square-Wave Voltammograms: Independence of Electrode Geometry, Koichi Aoki, Koichi Tokuda, Hiroaki Matsuda, and Janet Osteryoung, September 25, 1986.

12. Electrodeposition and Anodic Stripping of Silver on Single Carbon Fibers, Janusz Golas and Janet Osteryoung, September 25, 1986.

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18. Normal and Reverse Pulse Voltammetry at Microdisk Electrodes, Lin Sinru, Janet Osteryoung, John J. O'Dea, and Robert Osteryoung, July 1988.

19. Corrosion Measurements using Microelectrodes, Kazimierz Wikiel and Janet Osteryoung, July 1988.

20. Electrochemical Formation of Polypyrrole Films on $YBa_2CU_3O_{7-X}$, J. G. Osteryoung, L. J. Magee, Jr., and R. T. Carlin, May 31, 1989.

21. Analytical Utility of Cylindrical Microelectrodes, Scott T. Singleton, John J. O'Dea, and Janet Osteryoung, May 31, 1989.

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Fulbright Award

Garvan Medal of the American Chemical Society

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